

## CLAIMS

1. An interface, adapted to couple a patient's eye to a surgical laser system, the interface comprising:

an attachment ring, the ring overlaying the anterior surface of the eye;

5 a lens cone, the lens cone defining a first plane surface and coupled to a delivery tip of the surgical laser such that the delivery tip is positionally referenced to the first plane surface; and

a gripper, including a first receptacle for receiving the attachment ring, the gripper further including a central orifice for receiving the lens cone, the gripper stabilizing the relative positions of the lens cone and the attachment ring when the cone and ring are received within the gripper.

10 2. The interface according to claim 1, the lens cone further comprising:

an apex ring coupled to the first plane surface; and

an applanation lens disposed at a distal end of the apex ring, the applanation lens positioned in a second plane, parallel to the first plane such that the delivery tip is positionally referenced to the  
15 second plane.

3. The interface according to claim 2, the applanation lens further comprising:

an anterior surface;

an applanation surface configured to contact and applanate the anterior surface of the eye;

and

5 wherein the applanation surface defines the second plane, such that the delivery tip is positionally referenced to the applanation surface and thereby to the applanated surface of the eye.

4. The interface according to claim 3, wherein the apex ring is displaced from the first plane of the lens cone by a particular distance, the apex ring extending the applanation lens from the delivery tip by a corresponding distance such that the delivery tip of the surgical laser is referenced to the applanation surface and thereby the applanated surface of the eye in three dimensions.

5. The interface according to claim 1, the gripper further comprising:

15 a pair of expandable jaws, the jaws expanding a diameter of the central orifice when opened and contracting a diameter of the central orifice when allowed to relax; and

a pair of opposed lever handles, coupled to the jaws, the lever handles applying an opening pressure to the jaws when the opposed handles are squeezed together.

6. The interface according to claim 5, the lens cone further comprising:

an apex ring coupled to the first plane surface and including an outer diameter; and

an applanation lens disposed at a distal end of the apex ring, the applanation lens positioned in a second plane, parallel to the first plane such that the delivery tip is positionally referenced to the second plane.

7. The interface according to claim 6, wherein the gripper central orifice defines an inner diameter, the inner diameter sized to be smaller than the outer diameter of the apex ring, the gripper central orifice expandable to an inner diameter sufficient to receive the apex ring upon application of opening pressure to the lever handles.

8. The interface according to claim 7, wherein the jaws engage an outer surface of the apex ring upon relaxation of opening pressure applied to the lever handles, thereby retaining the apex ring and the lens cone in a generally fixed relationship with respect to the gripper.

9. The interface according to claim 2, the flexible attachment ring further comprising:

a flexible annular outer shroud, the shroud engaging the surface of the eye when in proximity thereto, the shroud defining an outer wall surface; and

an annular suction cavity formed in an upper surface of the attachment ring and in proximate contact with the outer wall surface of the shroud.

10. The interface according to claim 9, the attachment ring further comprising a fluid communication channel, coupled between the suction cavity and a vacuum source, wherein as the flexible attachment ring is positioned proximate to an eye, a suction is communicated to the annular suction channel thereby engaging the attachment ring to the eye.

11. The interface according to claim 10, the attachment ring defining an annular central opening, the opening sized to receive the applanation lens.

12. The interface according to claim 11, wherein the gripper engages the apex ring, thereby fixing a spatial relationship between the applanation lens and the attachment ring and thus the patient's eye.

13. The interface according to claim 4, wherein the applanation lens is aligned with respect to the apex ring by a golden pedestal, the applanation lens aligned with the delivery tip such that alignment tolerances between the delivery tip and the applanation surface are no greater than approximately +/- 30 microns in three dimensions.

14. The interface according to claim 13, wherein the alignment tolerances between the delivery tip and the applanation surface are no greater than approximately +/- 10 microns in three dimensions.

5 15. A flexible attachment ring adapted to interface between an anterior surface of a patient's eye and an applanation lens, the attachment ring comprising:

a flexible annular outer shroud, the shroud engaging the surface of the eye when in proximity thereto, the shroud defining an outer wall surface;

10 an interior annular wall surface, the interior wall surface concentrically disposed with respect to the outer shroud, the interior wall surface engaging the surface of the eye when in proximity thereto;

an annular suction cavity, the cavity defined by the outer and interior wall surfaces; and

15 a fluid communication channel, coupled between the suction cavity and a vacuum source, wherein as the flexible attachment ring is positioned proximate to an eye, a suction is communicated to the annular suction channel thereby engaging the attachment ring to the eye.

16. The attachment ring according to claim 15, further comprising:

a gripper, including a first receptacle for receiving the attachment ring, the gripper further including a central orifice for receiving an applanation lens; and

wherein the gripper stabilizes the relative positions of the appplanation lens and the attachment ring when the lens and ring are received within the gripper.

17. The attachment ring according to claim 16, wherein the vacuum source comprises a  
5 spring-loaded syringe, coupled to the attachment ring by tubing, the syringe developing an internal vacuum communicated to the suction cavity by the tubing.

18. The attachment ring according to claim 17, wherein the ocular pressure developed  
10 against an eye does not exceed approximately 60 mm Hg.

19. The attachment ring according to claim 18 wherein the ocular pressure developed  
against an eye falls within the range of from approximately 20 mm Hg to approximately 50 mm Hg.

20. An interface, adapted to couple a patient's eye to a surgical laser, the interface  
15 comprising:

flexible attachment means for overlaying the anterior surface of an eye and for stable engagement to the eye;

applanation means for defining an applanation surface, the applanation surface bounded by a plane and coupled to a delivery tip of the surgical laser such that the delivery tip is referenced to the plane; and

gripper means, including a receptacle for receiving the attachment means, the gripper further  
5 including engagement means for receiving the applanation means, the gripper means stabilizing the relative positions of the applanation means and the attachment means with respect to one another and thereby with respect to the patient's eye.

21. The interface according to claim 20, the flexible attachment means further  
10 comprising:

an annular suction cavity, disposed in a portion of the attachment means facing the anterior surface of an eye and in proximate contact with the anterior surface of the eye; and

a fluid communication channel, coupled between the suction cavity and a vacuum source,  
wherein as the attachment means is positioned proximate to an eye, a suction is communicated to the  
15 annular suction channel thereby engaging the attachment means to the eye.

22. The interface according to claim 21, the applanation means further comprising:

a lens cone, the lens cone defining a first surface and coupled to a delivery tip of the surgical laser such that the delivery tip is positionally referenced to the first surface;

an apex ring coupled to the first surface; and

an applanation lens disposed at a distal end of the apex ring, the applanation lens defining a second surface, referenced to the first surface such that the delivery tip is positionally referenced to the second surface.

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23. The interface according to claim 22, the applanation lens further comprising:

an anterior surface;

an applanation surface configured to contact the eye and applanate the anterior surface of the eye upon application of a pressure, wherein the applanation surface defines the second surface, such that the delivery tip is positionally referenced to the applanation surface and thereby to the applanated surface of the eye; and

wherein the first and second surfaces have a shape selected from the group consisting of a flat surface, a concave surface and a convex surface.

15 24. The interface according to claim 23, the gripper engagement means further comprising:

a pair of expandable jaws, the jaws expanding a diameter of the receptacle when opened and contracting a diameter of the receptacle when allowed to relax; and



a pair of opposed lever handles, coupled to the jaws, the lever handles applying an opening pressure to the jaws when the opposed handles are squeezed together.

25. The interface according to claim 24, wherein the gripper means receptacle defines an inner diameter, the inner diameter sized to be smaller than an outer diameter of the apex ring, the gripper means receptacle expandable to an inner diameter sufficient to receive the apex ring upon application of opening pressure to the lever handles.

26. The interface according to claim 25, wherein the jaws engage an outer surface of the apex ring upon relaxation of opening pressure applied to the lever handles, thereby retaining the apex ring and the appplanation lens in a generally fixed relationship with respect to the gripper means.

27. The interface according to claim 23, the gripper engagement means comprising a vacuum manifold, positioned to engage the apex ring of the lens cone, thereby retaining the apex ring and the appplanation lens in a generally fixed relationship with respect to the gripper means.

28. The interface according to claim 23, the gripper engagement means comprising a magnetized receiving manifold, positioned to magnetically engage the apex ring of the lens cone, thereby retaining the apex ring and the applanation lens in a generally fixed relationship with respect to the gripper means.

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29. A method for applanating an anterior surface of a patient's eye and coupling the eye to a surgical laser, the method comprising:

providing an interface, the interface including a central orifice, and having top and bottom surfaces;

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removably coupling a suction ring to the bottom surface of the interface;

positioning the interface over an operative area of an eye, such that the suction ring comes into proximate contact with the surface of the eye;

applying a suction to the suction ring, to thereby stabilize the position of the interface relative to the operative area of the eye;

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positioning an applanation lens in proximate contact with the operative area of the eye; and

coupling the applanation lens to the interface to thereby stabilize the position of the lens relative to the operative area of the eye.

30. The method according to claim 29, further comprising:

providing a lens cone, the lens cone defining a first plane surface;

coupling the lens cone to a delivery tip of the surgical laser such that the delivery tip is positionally referenced to the first plane surface; and

5 positioning the applanation lens at a distal portion of the lens cone, opposite the first plane surface, such that the applanation lens is thereby stabilized relative to the delivery tip.

31. The method according to claim 30, the lens cone further comprising:

an apex ring coupled to the first plane surface; and

10 wherein the applanation lens is positioned at a distal end of the apex ring, the applanation lens positioned in a second plane, parallel to the first plane such that the delivery tip is positionally referenced to the second plane.

32. The method according to claim 31, the applanation lens further comprising:

15 an anterior surface;

an applanation surface configured to contact the eye and appanate the anterior surface of the eye upon application of a normal pressure; and

wherein the appplanation surface defines the second plane, such that the delivery tip is positionally referenced to the appplanation surface and thereby to the applanated surface of the eye

33. A method for applanating an anterior surface of a patient's eye and coupling the eye to a surgical laser, the method comprising:

positioning a first portion of a coupling interface to an anterior surface of an eye, the coupling interface including a substantially rigid portion;

coupling the first portion to the anterior surface so as to stabilize the substantially rigid portion of the interface against motion relative to the eye;

positioning an appplanation lens in proximate contact with an operative area of the eye; and

coupling the appplanation lens to the substantially rigid portion of the interface, thereby stabilizing the position of the lens against motion relative to the operative area of the eye.

34. The method according to claim 33, wherein the first portion is generally flexible, the first portion including a suction ring configured to be disposed in proximate contact with an eye, the suction ring coupled to the eye by application of a vacuum to the suction ring.

35. The method according to claim 34, wherein the substantially rigid portion of the interface includes a central orifice configured to receive the applanation lens, the lens insertable within the central orifice, the central orifice engaging the lens and retaining the lens therein, thereby coupling the applanation lens to the substantially rigid portion of the interface.

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36. The method according to claim 35, further comprising:

providing a lens cone, the lens cone defining a first plane surface;

coupling the lens cone to a delivery tip of the surgical laser such that the delivery tip is positionally referenced to the first plane surface; and

10 positioning the applanation lens at a distal portion of the lens cone, opposite the first plane surface, such that the applanation lens is thereby stabilized in spatial registration with respect to the delivery tip.

37. The method according to claim 36, the lens cone further comprising:

15 an apex ring coupled to the first plane surface; and

wherein the applanation lens is positioned at a distal end of the apex ring, the applanation lens positioned in a second plane, parallel to the first plane such that the delivery tip is in spatial registration with respect to the second plane.

38. The method according to claim 37, the appplanation lens further comprising:

an anterior surface;

an appplanation surface configured to contact the eye and applanate the anterior surface of the eye upon application of a normal pressure; and

5 wherein the appplanation surface defines the second plane, such that the delivery tip is stabilized in spatial registration with respect to the appplanation surface and thereby to the applanated surface of the eye.

39. The interface according to claim 38, the substantially rigid portion of the interface  
10 further comprising:

a pair of expandable jaws, the jaws expanding a diameter of the central orifice when opened and contracting a diameter of the central orifice when allowed to relax; and

a pair of opposed lever handles, coupled to the jaws, the lever handles applying an opening pressure to the jaws when the opposed handles are squeezed together.

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40. The method according to claim 39, wherein the jaws engage an outer surface of the apex ring upon relaxation of opening pressure applied to the lever handles, thereby retaining the apex ring and the appplanation lens in a generally fixed relationship with respect to the interface.